South Lake Union Streetcar Project
Preliminary Engineering

Operating and Maintenance Plan

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Prepared for:
The City of Seattle Department of Transportation

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Chapter 1 Project Description

1.1 Overview

The City of Seattle, in cooperation with the U.S Department of Transportation Federal Transit Administration (FTA), proposes to construct a new streetcar line to serve the downtown, Denny Triangle and South Lake Union areas of Seattle. This line would provide local transit service, connect to the regional transit system, accommodate economic development, and contribute to neighborhood vitality. The project elements and construction are discussed in detail in the *South Lake Union Streetcar Project Description Memo* (Parsons Brinckerhoff, March 2005).

The proposed South Lake Union Streetcar would begin in the vicinity of the intersection of Westlake Avenue and Olive Way/5th Avenue in downtown Seattle (see Figure 3-1). It would extend north through the Denny Triangle and South Lake Union neighborhoods and terminate in the vicinity of Fairview Avenue N. and Ward Street near the Fred Hutchinson Cancer Research Center. The line would connect these neighborhoods and destinations with the regional transit hub at Westlake Center, which will be a major connection point for light rail, buses and monorail. The length of the proposed streetcar line is approximately 1.3 miles in each direction (2.6 track miles total) and the tracks and stops would be constructed entirely within existing right-of-way. The project would include three new traffic signals.

The streetcar would share the street with automobile traffic. Initially, the streetcar is expected to operate for 15 hours per day (roughly 6 AM to 9 PM), with fifteen minutes between cars. Ultimately, the system is expected to operate for 18 hours per day (roughly 5 AM to 11 PM), with ten minutes between cars.

As shown in Figure 1-1, streetcar stops would typically be side-platform corner-curb bulbs located within the parking lane at the far side of an intersection. Two stops would be center platform configurations: one within Fairview Avenue N. at the Fred Hutchinson campus and one in the railbank north of Valley Street adjacent to South Lake Union Park.

Bi-directional, low-floor, single-car, articulated streetcars are proposed. They are typically 66 feet long, 11.5 feet high, and 8 feet wide and run on standard gauge tracks. The streetcar would be powered by an overhead electrical system similar to those used by streetcars in cities such as Tacoma, Washington and Portland, Oregon. The low floor car technology is designed to meet all requirements of the Americans with Disabilities Act and to maximize ease of boarding and alighting for all passengers. To assure wheelchair access, curb heights at the accessible doorways will be 10 inches high. These curbs are higher than standard, but will not preclude joint streetcar/bus stops.

Fare collection is expected to be via "proof of payment" with riders being required to have monthly passes, tickets, or other prepaid fare instruments. Validated tickets for the streetcar will be sold via ticket vending machines on-board the vehicle, eliminating the need for wayside fare vending equipment. Regular transit fares would be collected for all

SLU streetcar trips; only the southern terminus is within the current "ride free zone." Fare inspection will be required to ensure that riders pay for their fare and carry proper fare instruments.

A maintenance facility at the southwest corner of Fairview Avenue N. and Valley Street is also planned as part of this project. The maintenance facility building would be approximately 100 x 70 feet. Two additional yard storage tracks would also be provided. Daily vehicle maintenance and inspections and minor repairs would be completed at the facility.

In the typical construction method for the streetcar track system, the top 12 to 18 inches of pavement would be removed and replaced with rail-embedded reinforced concrete slabs within a trench approximately eight feet wide. This project would also involve upgrading the stormwater detention system, relocation of utilities, and installation of traction power substations.

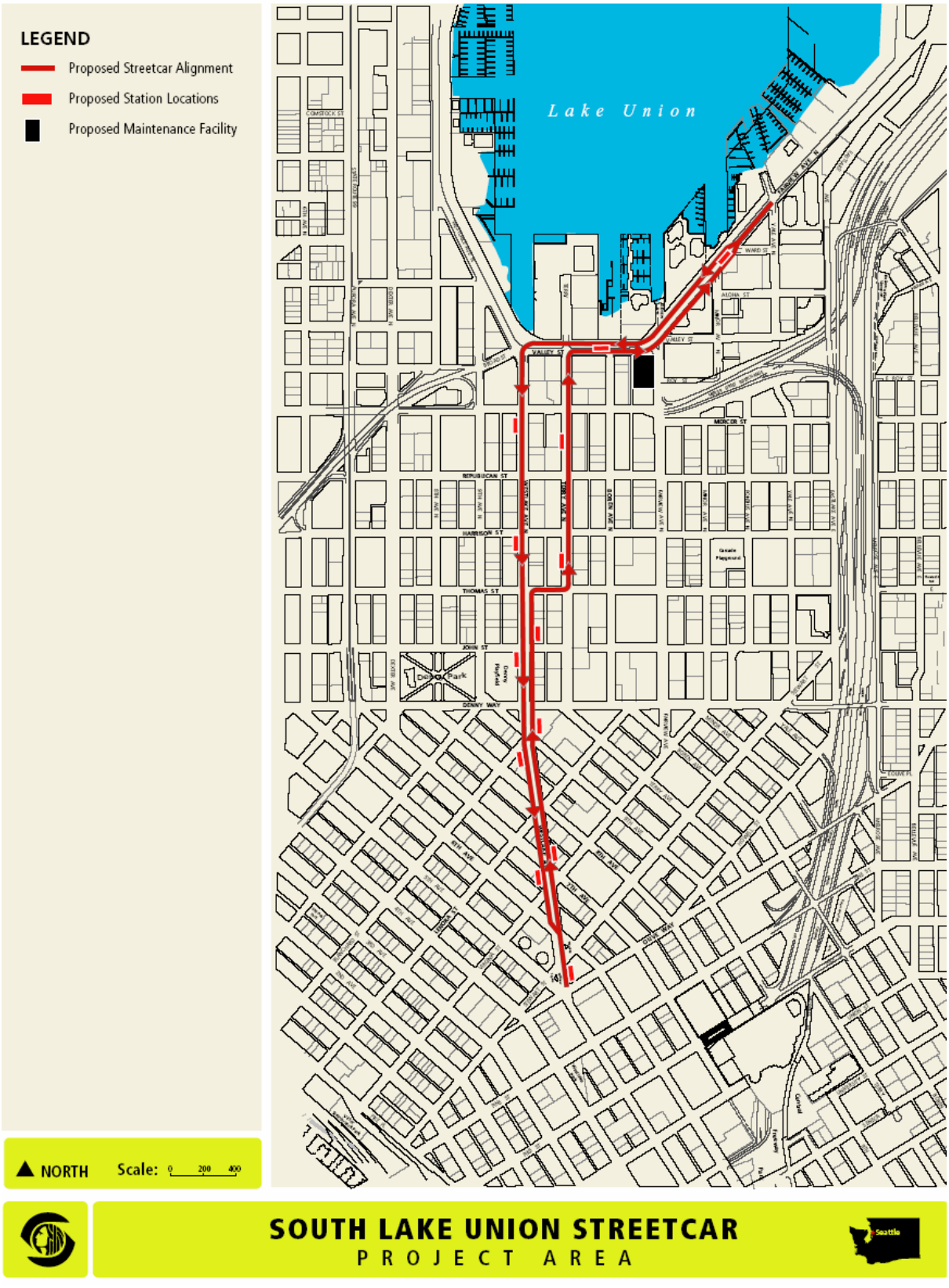

Figure 1-1: Project Area

Chapter 2 Operating Plan

This plan assumes that the South Lake Union Streetcar system will be operated by King County Metro. While Metro will operate the line, the operating plan will include substantial input from the City and other agencies or organizations providing operating funds. The exact nature of the relationship between these entities is still being developed. The operating plan and costs developed in this Operating Plan are expected to be accurate regardless of the exact method of operation. All costs were based on actual cost data from King County Metro, and represent both accurate local costs and the practices of other agencies that operate streetcar service.

2.1 Service Frequencies and Span of Service

Initially, service would operate every 15-minutes over a 15-hour service day, from approximately 6:00 AM to 9:00 PM. Service is expected to increase gradually, as development in the area increases, to a full service operation of service every 10 minutes over an 18-hour service day, by the time South Lake Union is fully built out. Service is expected to operate every day of the week to serve residents, employees and occasional and recreational riders in the area who will use the service.

Table 2-1 summarizes the primary elements of the operating plan for both short term (2007) and long term operations

Table 2-1 Operating Plan for South Lake Union Streetcar

Operating Plan Characteristic	Short Term 2007	Long Term (build out)
Service Frequency (Time between vehicles)	***15 minutes***	***10 minutes***
Service Span (number of hours of operation per day)	***15 hours***	***18 hours***
Hours of Operation (approximate)	***6 AM – 9 PM***	***5 AM – 11 PM***
Vehicles Required in Service at One Time	***2***	***3***
Total Vehicles Required	***3 to 4***	***5***
Total Revenue Hours of Service (Assumes 7 Day Operation)	***10,950***	***16,425***
Total Revenue Miles of Operation (Assumes 7 Day Operation)	***56,940***	***102,492***

The double-track design of the South Lake Union streetcar allows for the possibility of a future extension along Fairview to serve Eastlake and the University District. With the double track operation, it would be possible to ultimately operate a streetcar on the line every five minutes with a high degree of reliability.

2.2 Fleet Size

Although the initial operation requires only two vehicles in service at one time, a four-vehicle fleet is recommended to provide a suitable spare ratio. It will be possible to operate the line initially at 15 minute headways with three vehicles, but a fourth vehicle should be added as soon as funding can be secured. With only one spare, any body repair or component repair that takes a vehicle out of service for an extended period would completely consume the spare fleet, making it very difficult to guarantee full service. The spare ratio will decline over time as the vehicle fleet size increases.

2.3 Travel Speeds and Travel Time

Travel speed is a key variable in developing operating cost projections because it determines how quickly a given vehicle can make a round trip and begin the trip again. Travel speeds include the time required for stops as well as the speed operated between stops. Traffic model results show that the streetcar will initially operate between 9 and 10 miles per hour during the peak hour, including all delays at stops and traffic lights, and including all delays resulting from a mixed traffic operation.

Travel speeds are impacted by the choice of vehicle and other aspects of operations. The low floor vehicle, combined with proof of payment fare collection allow passengers to board and alight at all doors, and allows for very fast boarding of wheelchairs and riders with other mobility devices, including those using strollers, carrying packages or other impediments to using stairs. Stop dwell times are not expected to exceed 20 seconds for loading and unloading passengers.

While the streetcar should easily be able to average 9 to 10 miles per hour in its initial operation, its maximum operating speeds will be significantly higher. The streetcar must be able to travel at speeds averaging 12 miles per hour exclusive of stops to maintain overall travel times. Maximum operating speeds are expected to be between 18 and 20 miles per hour. The streetcar vehicles are capable of operating much faster than the speeds required by this service, and are designed to perform well on city streets. By the time full build out is compete, travel speeds are likely to decrease as congestion increases. Average speeds of 6 to 7 miles per hour, including dwell time at stops, are anticipated in the peak period, peak direction without any intervention or priority treatment.

2.4 Layover and Recovery

If the streetcar made a round trip without stopping for layover or recovery at the ends of the line, a round trip would require about 18 minutes. However, transit vehicles do generally have scheduled time at the ends of the line so that the vehicle can return to schedule (recovery) and so that the driver can have a break or be relieved (layover). Because service will be offered every 15 minutes, a total of 12 minutes of layover and recovery will initially be allocated on every round trip. This is more than adequate for such a short trip. Typical transit agency standards would require a minimum of five

minutes of layover for each trip plus approximately 10% of running time for recovery, or about 7 minutes total in each round trip.

Ideally, layover and recovery would be equally divided at both ends of the route, limiting the chances that two streetcars would meet at the same end of the line, even with significant line delay. However, the two ends of the line may not be equally conducive to driver "break time" or layover, and therefore, time may not be divided equally at the two ends of the line. At the south end of the line, the tail track is in exclusive right of way, and the driver will easily be able to exit the car safely and leave the car for personal time and/or for vehicle inspection. At the north end of the line, the tail track is in the street median, which offers an exclusive right of way that is safe for storing a vehicle, but does not provide a sidewalk or other walkway protected from traffic for the driver to leave the vehicle. At the north terminal, drivers will generally remain with their car. Inspections or other activity outside of the vehicle at the north end of the line will occur at the South Lake Union Park stop in the railbank north of Valley Street. Driver reliefs can also safely occur at this location, which is conveniently located near the access point to the maintenance facility.

Over time, as development increases in South Lake Union and throughout the region, street congestion will likely increase and travel speeds for all vehicles, including streetcars and auto traffic, will decrease. Initially, as travel speeds slow, streetcar running time will increase, and the layover and recovery time available to each vehicle will diminish. At some point, it may be necessary to take other steps to maintain a reliable service within the costs estimated in this Plan. The minimum operating speed to maintain 15-minute headways with two vehicles and with a minimum of 7 minutes of layover and recovery time per round trip is approximately 6 miles per hour. Traffic model results for 2030 suggest that speeds of 6 miles per hour can be maintained even in that target year. However, if speeds do decrease or if on-time performance is unduly affected by congestion, the City of Seattle may ultimately choose to utilize one or more of the tools available to maintain transit speeds. These tools include:

- Adjusting the timing of signal lights to increase the opportunity for "green" phase for streetcars.
- Providing for signal pre-emption for streetcars.
- Reduce the number of stops or consolidate stops to improve overall travel times.
- Adjusting the street network, revisiting one-way street configurations and other lane configurations to minimize conflicts between streetcars and automobiles.

While some type of transit priority treatment is likely to be necessary in the long term to maintain streetcar speeds, this issue is not limited to streetcar service, but will affect all transit lines competing with auto traffic on busy streets. The techniques utilized to protect streetcar speeds will be identified over time, and may be implemented incrementally. It should be noted that no special treatment is required in the short-term, and there is no specific date when intervention may be required.

2.5 Driver Reporting and Reliefs

Streetcar drivers may or may not report directly to the maintenance facility. Because the number of required drivers is expected to be small, streetcar drivers could report to a full service Metro division, such as the Atlantic/Central/Ryerson base complex in the vicinity of 6th Avenue S. and S. Royal Brougham Way. Under this scenario, dispatch and supervisory personnel at the base would manage the streetcar line along with their assigned bus routes and streetcar drivers would be shuttled to/from the streetcar maintenance facility at the beginning and end of their workday. The other option is for streetcar drivers to report directly to the maintenance base, which would require having supervisory personnel at the streetcar base. The cost model assumes that the drivers report to a bus base, which may be a more costly option.

Because each vehicle will operate over a 15-hour day, while driver shifts will be only about 8 hours each day, in-service driver reliefs will be required, where a new driver replaces an operator going out of service. Reliefs may occur in one of two locations – either at the south terminus of the line at Westlake or at the South Lake Union Park station.

All vehicles will enter and exit the revenue tracks enroute to/from the maintenance facility using the signalized intersection of Valley and Fairview. This intersection will be designed with a signal phase that can stop all traffic in both directions to allow for the safe passage of a streetcar. Streetcars are not expected to enter or leave revenue service during peak periods, as streetcars will be scheduled to enter the system before roughly 6 AM and after 9 PM.

2.6 Delay and Recovery Operations

The running time and recovery time allocated to this line should result in a very reliable operation. However, in all transit operations, especially one running on fixed guideway in mixed traffic, delays and service stoppages will occasionally occur. In all cases, communication with the public is a crucial element of any delay and recovery situation. King County Metro is experienced with communications of this type and will provide necessary line management and supervisory personnel to manage any incident that occurs on the streetcar route.

The following describes the recovery operations expected to manage common incidents:

2.6.1 Shortline Operation

Crossover tracks are planned for the area adjacent to the South Lake Union Park Station. Trains would be able to “cross over” from one direction to the other at that station, making it possible to run a shorter line from either terminal to South Lake Union. Short line operation can be used when a terminal is blocked due to an out of service vehicle or some other incident, and may also be useful for returning to schedule after a service delay.

2.6.2 Service Delays

Service delays of up to 10 minutes can be managed within the layover and recovery time planned for the line. Operators would maintain their schedule by reducing the time available at the end of the line.

Should less recovery time be allocated, or should travel speeds slow, it will not be possible to manage significant delays without affecting line operations. For longer delays that cannot be managed within recovery time, it will be important to manage service headways so that streetcars don't become "bunched". It is especially important that streetcars not "meet" at the same end of the line, making turning operations more complicated. Drivers will be able to communicate through their dispatcher to ensure proper headway separation.

2.6.3 Stalled or Disabled Streetcar

On the rare occasion when a streetcar must be taken out of service, the streetcar may be "pushed" or towed back to the maintenance facility or into one of the terminal tail tracks, resulting in short line operation. Once removed from the revenue tracks, a spare vehicle may be put into service and regular service resumed.

2.6.4 Line Blockages or Construction Activity

A more severe type of delay occurs when the tracks are blocked. This generally occurs when a vehicle is illegally parked, or due to a traffic incident separate from streetcar operations. Street construction work and emergency vehicle needs are also occasional sources of line blockages. While these types of problems are very infrequent, they can be severe. Depending on the location of the line blockage, short line service may be operated. It may be necessary to supplement short line service with some bus service to provide reasonable service levels to all stops. In cases where short line service is not feasible, the line will be shut down and streetcar service may be replaced with temporary bus service. In this case, streetcar operators will make every effort to travel back to the maintenance facility, or to a terminal location, where vehicles can be stored without further disrupting traffic.

2.6.5 Bus Substitution

During periods when it is not possible to operate streetcar service due to lengthy service disruptions, bus substitution service will be implemented along the streetcar route. Buses will utilize streetcar stops where possible. Should a service disruption of more than a few hours be required, signage and other information will be provided to help direct passengers to buses. Station reader board signs will also indicate the bus substitution route and stops.

2.6.6 Shutdowns for Utility or Roadway Work

It is assumed that some utility and/or roadway construction work can be done in the vicinity of the streetcar while the streetcar is in operation, but some utility and/or

roadway work will require the streetcar line to be shut down for some period of time. During shutdowns of the line, substitute bus service would be provided and riders would be given information to help plan their trips.

Chapter 3 Ridership

The Seattle Streetcar Network Feasibility Study estimated ridership for the South Lake Union streetcar line based on the existing and potential markets for transit service in general, and streetcar service in particular, linking the developing South Lake Union and Denny Triangle areas with the Westlake transit hub. The ridership analysis takes into consideration a number of factors that are known to contribute to transit ridership, they are:

- Intensity of land use within walking distance – including both residential and employment density, both in 2007 and at build out.
- Mix of land uses – residential, employment, retail, recreational - existing and at build out.
- Frequency of service – assuming 15 minute service initially and 10 minute service by build out.
- Fares – full Metro fare collection is envisioned, via proof of payment fare collection.
- Connectivity to a broader network – including the Westlake transit hub.
- Legibility and information assuming a high level of orientation and wayfinding information.
- Comfort provided via modern streetcar vehicles.

Initially, the streetcar is projected to carry between 330,000 and 380,000 riders per year. By the time the build out of South Lake Union is complete, the streetcar could carry between 1.1 and 1.2 million riders per year. The growth in ridership is dependant on the speed at which the planned development in South Lake Union occurs as well as the ultimate mix of land uses.

3.1 Relationship to Existing Bus Service

Because the South Lake Union streetcar does not initially replace any existing bus routes, the majority of streetcar riders are assumed to be making new transit trips. These will come from new work-related trips attracted to new jobs in the South Lake Union area, from new residents, and from visitors and occasional users, visiting the South Lake Union Park and other attractions in the area. Riders will include those using the Streetcar to connect to the regional transit system at the Westlake hub.

Chapter 4 Maintenance Plan

Implementation of the South Lake Union Streetcar line will require new maintenance activities for vehicles, trackway and stations.

4.1 Vehicle Maintenance

King County Metro does not currently maintain any modern streetcars similar to those that will operate in South Lake Union. The maintenance plan calls for routine and lighter maintenance activities to be completed on site by Metro employees while heavy maintenance will be done off site, at one of Metro's existing maintenance facilities or under contract to specialized vendors. Vehicle maintenance requirements can be divided into the following categories.

- **Daily Maintenance** – Interior cleaning, sanding (as required), exterior cleaning.
- **Inspections** – Daily and cyclical preventive maintenance inspections of equipment and components to insure state of good repair. Depending on the local statute and vehicle codes the vehicle may require a state inspection.
- **Running Repairs** – Reactive type of maintenance to attend to problems that can affect the in-service performance of the vehicle; e.g. broken glass, graffiti, and trouble lights affecting propulsion and braking. These maintenance items require quick action to repair and return to service.
- **Component Change-out/Cyclical maintenance** – This category is two staged. Component change out can be required for either a repair or a cyclical maintenance item. When a major component fails or has reached the end of its predictable service life it will need to be removed and replaced. Both are categorized as component change outs but for entirely two different reasons.
- **Heavy Repair** – Major accidents requiring extensive body repair, frame repair and repainting.
- **Overhauls** – Time or mileage based cyclical maintenance that entails the removing, rebuilding, replacing of all major components involved with the state of good repair of the subject vehicle.

Each of the categories above has a list of sub-categories that represent daily or periodic tasks that have been considered in the cost of system operations

4.1.1 Daily Maintenance Tasks

- **Interior Cleaning** – Space and cost required will be included in the yard lay-up area. Interior cleaning can be accomplished as the vehicles are out of service for off peak hours or non-service hours. Equipment required would include the obvious tools of the task (mops, brooms buckets, etc…). Space will be required for storage of the cleaning equipment and the chemicals necessary to complete the task.

- **Exterior Cleaning** – There are two options available. First, is the installation of a car wash. This self contained system sprays cleaner onto the vehicle, spaces a dwell time for cleaner reaction, brushes the exterior of the vehicle after the cleaner application and dwell, then rinses the vehicle. This option can be expensive and requires an inordinate amount of space in a storage facility for a fleet of this size and is not included in this plan. The second option is to locate hose bibs and possibly mid level platforms in the storage area for hand washing of the vehicles. The space required for this task is the same as for interior car cleaning, to store the equipment and chemicals required to accomplish the task.

- **Sanding** – Assuming that the selected vehicle will use a sanding feature for traction assist for both braking traction and propulsion traction, there are two alternatives. First, a sanding tower that utilizes an air pressure system to deliver dry sand through a pipe/hose system to a nozzle. The nozzle is then used to deliver the sand to the hopper box on the vehicle. This option can be expensive and requires an inordinate amount of space in a storage facility for a fleet of this size. The other alternative is to use bagged sand and manually fill the sanding units. Given the small number of vehicles in the initial fleet, manually filling the sanding units is recommended until a larger fleet and/or facility are implemented.

4.1.2 Inspections

- **Daily/Safety Inspections** – Inspection entails a walk-around/walk-through inspection to ensure safe, clean, timely operation of the vehicle. This inspection can be performed by a mechanic and/or the operator of the vehicle prior to release for in-service operations. This inspection can be performed in the storage yard, and will focus on visual inspection of truck mounted equipment for secure mounting and state of good repair of braking equipment. The walk through would look for lighting, door operations, mounted equipment (mirrors, etc…), and a terminal brake test (verifying safe brake operation). Space required to perform this inspection will be included in the storage yard area. Aisles will be spaced to allow inspectors to walk completely around the vehicles being stored. Additional visual inspections may be completed on route as needed.

- **Cyclical/Periodic Inspections** –Cyclical/Periodic Inspection or Preventive Maintenance Program (PMP) are typically time or mileage based. Given the relatively small number of miles that will be operated on a given day, a time-based program is recommended to start. Each vehicle in the fleet will be inspected no less frequently than on a 90-day cycle, and inspections will be directed at improving reliability through early detection of failing components and the timely correction of minor defects that impact service. During the inspection, the proper functioning of all systems including cab signals, event recorders, air brakes, propulsion systems and controls are verified and defects are corrected. On a 2-year cycle, the PMP includes truck removal for center casting inspection and also includes scheduled replacement of other major components, such as air valves, shock absorbers and the master controller. On a 5-year cycle, the PMP includes all elements above with the addition

of a full truck and wheel set rebuild. Other components will also be rebuilt based on the manufacturers suggested maintenance schedule. These inspections and repairs will be performed in the dedicated maintenance facility described in Section 1.6.

4.1.3 Running Repairs

- Running repairs are defined as repairs that can be easily accomplished by pulling the vehicle off the line, out of revenue service, into the facility and completing the repairs in less than approximately four hours. Examples of Running Repair incidents would be broken/missing passenger glass, propulsion failure indication lights, and door system malfunctions. Running repairs will be performed in the dedicated maintenance facility described in Section 1.6; which will be shared with inspection/preventative maintenance tasks.

4.1.4 Component Change-out

- When a major component fails it will need to be removed and replaced. Space and equipment will be allocated to perform component change-out of roof level equipment and truck-mounted equipment. Repair of the subject equipment will be contracted to qualified vendors or to a compatible facility within the Metro system.

- When a major component has reached the end of it predictable service life, it will need to be removed, rebuilt, and replaced. This would relate to the 5-year cyclical inspection/preventive maintenance program, as described above. Space and equipment can be expensive and these tasks can be accomplished off-site by removing the component and delivering it by truck to the closest vendor facility.

4.1.5 Heavy Repairs and Accident Damage

- Heavy repairs would be defined as any repair that requires the vehicle to be out of service for a predetermined amount of time to facilitate body repair. Accident repair trains are removed from service whenever they are involved in a collision incident and the resulting repairs will consume a considerable amount of time before being put back into service. Major collision repairs will be done off site, potentially in another Metro facility with paint and body capabilities.

4.2 Right of Way Maintenance

Right of way maintenance includes maintenance of the trackway, overhead power system, and station areas. The cost model assumes that these maintenance tasks will be completed by King County Metro, similar to their current maintenance of the waterfront streetcar line. The cost model has been updated to reflect the tasks required for in-street maintenance, including the maintenance of upgraded bus shelters and stop amenities as well as for the short section of tie and ballast track north of Valley Street.

The proposed stations are designed for ease of maintenance. Trash collection will need to occur daily at higher volume stations, and at least weekly at lower volume stations. Routine maintenance of shelters and other amenities will be required.

The cost estimates developed in this report assume that station maintenance is done by King County Metro. Ultimately, this may be refined if an alternative vendor is selected.

Chapter 5 Operating Cost

5.1 Cost Model

A preliminary operating cost model was developed for the South Lake Union Streetcar that is based on the current costs for labor, power, and other materials purchased by King County. Data from other systems was used to quantify some items that Metro does not currently have experience with, however, all costs were updated to reflect local conditions.

The cost model is based largely on information gathered from King County Metro's submission to the National Transit Database. King County Metro provided their most recent data, for the fiscal year completed on June 30, 2003. Costs are presented in 2004 dollars, using an inflation factor of 1.0244 to inflate 2003 costs to 2004 dollars. To translate King County Metro's current cost structure for the waterfront streetcar to the structure necessary for a modern streetcar operation, cost data from Portland, Tacoma and Salt Lake City were also considered in the development of the cost model.

The cost model assumes that all functions related to the operations and maintenance of the streetcar line are done by Metro, either under contract to the City or as a direct Metro line. To account for an allocation of overhead and general administrative expense, actual costs of operation are inflated by 10.4%.

The cost model is designed to provide a comprehensive estimate of operating and maintenance costs for the South Lake Union Streetcar line. All costs have been allocated in this model. It is possible that the City of Seattle, or Metro itself may wish to contract for some services, or to operate them differently than a standard "turn key" operation. These alternatives may have an impact on the overall costs, and in particular, may allocate some costs differently between partner agencies and vendors.

In addition, it should be noted that this model is not intended to be directly scalable as the service increases. For example, operating a 15-hour service day can be done with two eight-hour drivers being assigned to each streetcar. Should service increase to an 18-hour service day, overtime may be required to fill the hours, at a higher rate. Drivers will not be easily "interlined" between streetcar service and other routes since the South Lake Union line will be the only line operating this particular type of vehicle. This makes changes in the scale of service more difficult to cost. A separate cost estimate for full build out operating costs is provided at the end of this document.

This cost model is not intended to develop a line item budget, but rather to break the cost of providing streetcar service down to its basic elements. These elements are summarized in Table 5-1.

Table 5-1 South Lake Union Operating Cost Model – Key Elements

Cost Item	Major Cost Elements	Unit Cost
Vehicle Operations	***Streetcar operators*** ***Other salaries including supervision and fare inspection***	***$62.09*** ***per revenue hour***
Material and Services	***Materials and Supplies*** ***Power*** ***Parts including lubricants and consumables***	***$1.42*** ***per revenue mile***
Vehicle Maintenance	***Maintenance Labor (fully burdened)*** ***Other salaries and support contracts***	***$119,901*** ***per peak vehicle***
Non-Vehicle Maintenance	***Maintenance of trackway and stations***	***$98,881*** ***per track mile***
General Administration	***Allocates costs for system overhead as well as line level overhead to the streetcar system.*** ***Costs maybe lower if the route is operated directly by Metro than if full allocation is required for contract.***	***10.4%*** ***add-on to sum of above factors***

As the City of Seattle and King County Metro settle on exactly how this line will be operated (i.e. contracted operation with the City owning the physical infrastructure or a standard Metro line with Metro owning the infrastructure), these costs may be refined. However, they have been designed to include all allocated costs for overhead and administration as well as the direct costs for operations and maintenance. Costs related to fare inspection, maintenance of right of way and stations have been included, although specific responsibilities for those functions are still being negotiated.

5.1.1 Key Assumptions in the Operating Cost Model

The Operating Cost model is based on actual unit costs for King County Metro service, with additional information gained from current operators of modern streetcar service, including those in Portland, Tacoma, and Salt Lake City. Key assumptions are listed below.

Vehicle Operations

Vehicle operations include the salaries and wages necessary to provide service – including streetcar operators, supervision and fare inspection. Wage and fringe rates were based on Metro's National Transit Database cost submission. The vehicle operations cost per revenue service hour for the South Lake Union Streetcar is expected to be significantly less than the current cost for operating the waterfront streetcar because the waterfront line requires both a driver and conductor on every car. To convert Metro's

current costs for vehicle operations to a cost consistent with a single operator vehicle, a new labor productivity factor was developed for the South Lake Union Streetcar. Currently, Metro pays about 2.17 labor hours for every hour of service on the waterfront streetcar. This includes the two operators on the car, and the fact that drivers are paid for some amount of non-revenue time or overtime in a typical schedule day. To calculate a similar factor for the South Lake Union Streetcar, the model assumes that labor productivity on this line will be consistent with other bus lines in the Metro system. On bus routes, Metro pays 1.35 labor hours for every hour of service. This labor productivity factor was increased from 1.35 to 1.55 in the cost model to include the costs for fare inspection and all supervision.

In the initial operating plan, there are opportunities to improve this labor productivity rate. By operating 15-hours of service daily, two drivers, each operating an 8-hour shift can be assigned to each car. The resulting labor productivity of less than 1.1 pay hours per revenue service hour would offer a significant savings to the initial operation. However, the costs included in the model are intentionally conservative to allow for unknowns in the non-driver labor cost categories.

Operations Materials and Services

While most of the cost of operating the streetcar line can be attributed to the hourly cost of operations, the costs of materials, supplies and services are charged on a per mile or per peak vehicle basis. Costs for materials and services were based on the current waterfront streetcar, validated by NTD data.

Vehicle Maintenance

Costs for vehicle maintenance were based on the current waterfront streetcar, adjusted for the actual cost experience of Portland and Tacoma on modern streetcar vehicles. All unit costs were derived from current reported Metro data.

Non-Vehicle Maintenance

Non-vehicle maintenance includes maintenance of right of way and stations. Here, current Metro data for the waterfront streetcar was not relevant to the proposed line, because maintenance on the current tie and ballast railroad system is less costly than maintaining an in-street railroad. In addition, it does not appear that Metro fully allocates even its current costs, according to the NTD data. For non-vehicle maintenance, the model utilizes experience data from Salt Lake City, Utah's at-grade light rail system. Their cost structure is comparable to Metro's, and their cost of $98,881 per track mile is included in the cost model.

General Administration

The overhead factor of 10.4% is taken directly from Metro NTD data, dividing the total administrative cost over all revenue hours of service. While Metro does not currently

apply overhead costs specifically to streetcar operations, we assume that overheads will be uniformly spread over the entire system including the South Lake Union line.

Start-Up Costs

No specific allocation for start-up costs was included in the model. We assume that first year start-up costs would not exceed 10% of the operating budget for the first full year of operations, based on the anecdotal examples of other systems. Start-up costs include vehicle inspection, testing and break in, driver and mechanic training and training for other staff involved in streetcar operations. These one time costs are enumerated in the following section, but are not included in the model.

5.1.2 Initial Operating Cost Estimates

Using the cost model described above and the operating plan described earlier in this report, the initial operating cost for the South Lake Union Streetcar is expected to total approximately $1.4 M. This estimate includes all administrative overheads and is based on a conservative assumption about labor productivity. An additional 10% of the initial operating budget or about $137,000 is budgeted in one time start up costs for training and implementation of the line. All costs are shown in 2004 dollars.

The calculation of operating costs is shown below:

Table 5-2 Initial Operating Costs

Assumes 15-minute headways and 15-hour service spans

Cost Model Factor	Unit Cost	Initial Number of Units from Operating Plan	Total Cost
Revenue Hours	***$62.09***	***10,950***	***$679,885***
Revenue Miles	***$1.42***	***56,940***	***$80,855***
Peak Vehicles	***$119,901***	***2***	***$239,802***
Track Miles	***$98,881***	***2.5***	***$247,203***
Subtotal			***$1,247,745.00***
Administrative Overhead	***10.4%***	***-***	***$130,000***
Total			**$1,377,745**
One-Time Start-Up Costs	***10%***		***$137,000***
TOTAL INCLUDING START-UP			***$1,514,745***

5.1.3 Staffing Requirements

Staffing required for the streetcar operation includes drivers and maintenance staff, supervision and fare inspection. These positions have all been accounted for in the cost estimates.

Drivers and Line Management

Initially, the streetcar will operate 15-hours each day, 7 days per week. This operating plan can be met with four drivers, each driving an 8-hour shift. At least one "extra board" driver will need to be available to the streetcar system at all times. Metro may choose to train a pool of potential streetcar drivers who may all alternate as the extra board for the streetcar as well as serving as extra board for the bus division where they are based. To cover all shifts 7-days per week, a minimum of 9 drivers will need to be trained to drive the streetcar.

Line supervision and dispatch for the streetcar line will be incorporated into the responsibilities of the local bus division. Separate dispatch and supervision are not anticipated for this short line, however, a portion of the cost of supervision and dispatch have been allocated to the streetcar operations to account for the need for these functions. A total of 18 hours per week of fare collection and supervision are budgeted in the initial operating plan, as reflected in the efficiency factor.

Maintenance Staff

Metro will have some flexibility in staffing this small facility. A total of three full time maintenance workers per day are assumed to be on site and a total of five trained maintenance staff will be needed to fill all shifts, seven days per week.

Fare Inspection and Supervision

In a proof of payment fare system, such as proposed for this streetcar line, there must be a credible "threat" of inspection and ticketing to encourage riders to pay their fares. On a line of this size, it is not necessary to have full time fare inspection, but random inspections should occur to keep passengers honest about fare payment. In addition, every transit line requires some level of supervision, to maintain reliability and provide assistance during incidents and delays. About 18 hours per week has been budgeted to cover fare inspection and supervision needs, which would be done periodically, at various times of day and on various days of week. Costs for fare inspection and supervision have been included in the cost factor for operating costs.

Table 5-3 summarizes staffing assumptions for the initial operating plan:

Table 5-3 Staffing Assumptions

Position	Included in Cost Category	FTE Assumption
Drivers	***Revenue Hours***	***9 (includes extra board drivers who will not be assigned full time to streetcar)***
Fare Inspectors, Supervision, and Associated Dispatch and other Operations Support	***Revenue Hours***	***2 (includes portions of individual FTE doing various jobs)***
Vehicle Maintenance Workers	***Peak Vehicles***	***5 (1.5 FTE per shift 7 days per week, 2 shifts per day)***
Other Maintenance	***Track Miles***	***Included in cost formula but not linked to FTE***
Admin Support	***Overhead***	***Included in cost formula, not tied to FTE***

5.2 Longer Term Costs

The long term operating plan for the South Lake Union Streetcar calls for a longer operating day and more frequent service, increasing both revenue hours, and miles, as well as the number of peak vehicles required. The results of this service increase on operating costs are shown in Table 5-4. It is likely that the operating plan will not simply "jump" from the initial 15-minute service, 15-hour day, to the 10-minute service and 18-hour day shown here, but rather will increase gradually to this higher level of service.

Table 5-4 Longer Term Operating Costs

Assumes 10 minute headways and 18-hour service day

Cost Model Factor	Unit Cost	Initial Number of Units from Operating Plan	Total Cost
Revenue Hours	***$62.09***	***16,425***	***$1,019,828***
Revenue Miles	***$1.42***	***102,492***	***$145,538***
Peak Vehicles	***$119,901***	***3***	***$359,703***
Track Miles	***$98,881***	***2.5***	***$247,203***
Subtotal			***$1,772,272.00***
Administrative Overhead	***10.4%***	***-***	***$184,316***
Total			***$1,956,588***